

## Cardioderma cor. By Ryan Csada

Published 17 May 1996 by the American Society of Mammalogists

### *Cardioderma* Peters, 1873

*Cardioderma* Peters, 1873:488. Type species *Megaderma cor* Peters, 1873, by original designation.

**CONTEXT AND CONTENT.** Order Chiroptera, Suborder Microchiroptera, Family Megadermatidae. Peters described *Megaderma cor* in 1872. In the following year, he proposed the subgeneric name *Cardioderma* for this species, without any further characterization. Since then, most authorities have given *Cardioderma* full generic rank. The genus *Cardioderma* contains one extant species.

### *Cardioderma cor* (Peters, 1872)

#### African False Vampire Bat

*Megaderma cor* Peters, 1872:194. Type locality Abyssinia (= Ethiopia)

**CONTEXT AND CONTENT.** Context as in generic account above. No subspecies are currently recognized.

**DIAGNOSIS.** *Cardioderma* can be distinguished from the only other African megadermatid, *Lavia frons*, by skull and tooth characteristics. The posterior pair of angles of the frontal shield do not form postorbital processes and the upper surface of the shield is strongly concave in *Cardioderma* (Fig. 2). In *Lavia*, postorbital processes are formed and the shield is relatively flat. In *Cardioderma*, cusp 3 of  $m^1$  is moved backward and the antero-internal basal cusp of the upper canines is lost. In *Lavia*,  $m^1$  is normal and the cusp on the upper canines is present. In *Cardioderma*, the noseleaf is smaller (<10 mm) and the tragus is shorter and broader.

**GENERAL CHARACTERS.** *Cardioderma* (Fig. 1) is a relatively large (21–35 g) microchiropteran and lacks sexual dimorphism. It has large eyes and large conjoined ears. The heart-shaped noseleaf is relatively small and evenly rounded above. The tragus has a quadratic or rounded inner lobe. There is no external tail and the interfemoral membrane is well developed. The fur is long and loose and is a uniform blue-gray color.

The following external measurements (in mm;  $n = 10$ ; sexes not specified) are from Anderson and Wroughton (1907): length of head and body, 70–77; length of ear, 35–39; length of exterior lobe of tragus, 15.5–18.5; length of interior lobe of tragus, 9.5–12; length of noseleaf, 11.5–15.5; breadth of noseleaf, 7–8.3; length of forearm, 52.7–57; length of metacarpal III, 36.5–42; length of first phalanx, 17.5–23.5; length of second phalanx, 33.5–40; length of metacarpal IV, 38.5–44; length of first phalanx, 11–13.5; length of second phalanx, 17.5–20; length of metacarpal V, 43–48; length of first phalanx, 11.5–14; length of second phalanx, 14.5–17; and length of lower leg, 29–31.5.

The following skull measurements (in mm;  $n = 10$ ) are also from Anderson and Wroughton (1907): greatest length, 25.7–26.3; breadth of brain case, 10.5–11; breadth across zygomata, 15.3–15.5; maxillary tooth row, 10–10.3; and mandibular tooth row, 11.2–11.5.

**DISTRIBUTION.** *Cardioderma* is found in east Africa, including eastern Sudan, Ethiopia, Somalia, northern and eastern Kenya, northern Tanzania, and Zanzibar (Hayman and Hill, 1971; Koopman, 1975; Fig. 3). Kingdon (1974) reports that this species reaches its southern limit in northern Zambia. *Cardioderma* may also occur in suitable habitats in Uganda, Rwanda, and Burundi.

*Cardioderma* typically inhabits dry lowland and coastal strip habitats, although it has been caught foraging in river valleys (Varty and Hill, 1988). The highest altitudinal record of a captured individual is 940 m (Vaughan, 1976).

**FOSSIL RECORD.** A *Cardioderma* sp. from the late Pliocene has been reported (Butler and Greenwood, 1965). No additional information was given.

**FORM AND FUNCTION.** The dental formula is  $i\ 0/2$ ,  $c\ 1/1$ ,  $p\ 1/2$ ,  $m\ 3/3$ , total 26. There is a reduction of the mesostyle in  $m^1$  and  $m^2$  and consequent distortion of the W pattern. There is also a reduction of the posterior segment of the lower molars (Miller, 1907).

The hyoid musculature of *Cardioderma* differs in the following ways from other megadermatids. The insertion of the Mylohyoid (M) ceratohyoideus is reduced and restricted to the posterior surface of the medial half of the ceratohyal. The origin of M. hyoglossus is not completely detached from the basihyal element, but is detached from the basihyal raphe and from the lateral basihyal. M. geniohyoideus has a weak attachment of the superficial raphe and M. jugulohyoideus is absent (Griffiths et al., 1992).

African false vampire bats have exceptionally large eyes and pinnae compared with other insectivorous bats. These qualities are important in prey localization (Ryan and Tuttle, 1987). For example, large pinnae supply high sound pressure gain at lower frequencies (Obrist et al., 1993).

Audible (to humans) vocalizations include a "territorial song" and "flight call" (Vaughan, 1976:233). The territorial song consists of 4–9 high intensity pulses of approximately 12 kHz. Flight calls



FIG. 1. Photograph of *Cardioderma cor* (courtesy M. D. Tuttle, Bat Conservation International).



FIG. 2. Dorsal, ventral, and lateral views of the cranium and lateral view of the mandible of a female *Cardioderma cor* (length of skull = 26.0 mm; Royal Ontario Museum specimen 78078; photographs by B. Boyle).

consist of a series of pulses (usually 3–10) that are more widely spaced than the song and each pulse has a rise in frequency peaking at 12 kHz. Echolocation calls of *Cardioderma* have most energy at 42 kHz and include a harmonic at 63 kHz (O'Shea and Vaughan, 1980).

The wing aspect ratio of *Cardioderma* (5.7—O'Shea and Vaughan, 1980) facilitates its ability to maneuver in clutter. The wing-tip index is average for a bat (1.7—McWilliam, 1987) and

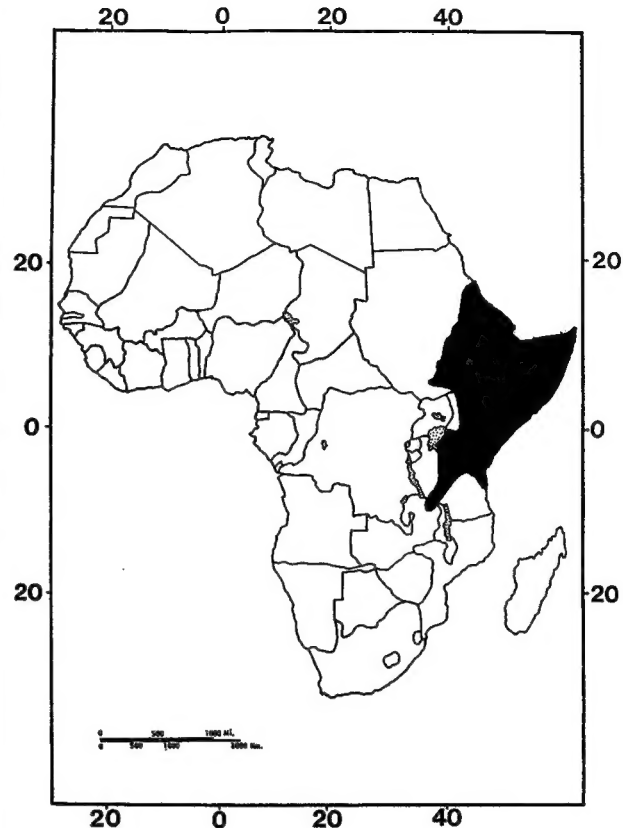


FIG. 3. Distribution of *Cardioderma cor* in Africa.

mitigates against hovering. The echolocation call design and wing morphology of *Cardioderma* are characteristic of gleaning African bats (O'Shea and Vaughan, 1980).

It is not likely that *Cardioderma* undergoes torpor. Other species in this family (e.g., *Macroderma gigas*) are obligate homeotherms (Leitner and Nelson, 1967).

**ONTOGENY AND REPRODUCTION.** Although lactating females have been caught throughout the year in Kenya, most reproduction appears to occur in each of the two rainy seasons (March–June and October–December—McWilliam, 1987). The number of young caught with each mother (Vaughan, 1976) suggests that each female gives birth to one pup. Happold and Happold (1990) classify this breeding strategy as seasonal bimodal polyestry, a pattern which is typical of many other species of bats in Africa (Racey, 1982).

Gestation appears to be approximately three months. Young are born blind and hairless and are carried by the mother for about two months (Kingdon, 1974). Although more males than females were caught by McWilliam (1987), there is no evidence that sex ratio differs from unity.

**ECOLOGY.** *Cardioderma* occupies day roosts in caves, hollow trees (e.g., baobab, *Adansonia digitata*), and abandoned buildings, such as Masai huts (Kingdon, 1974; Ryan and Tuttle, 1987; Vaughan, 1976; T. A. Vaughan, in litt.). Baobab trees ( $n = 4$ ) occupied in Vaughan's (1976) Kenya study housed up to 81 bats in a single tree. These trees had cavities that were at least 2 m high and 1.8 m wide and had openings approximately 1.6 m above the ground. Kulzer (1962) found a colony in a dry cave 10 m from a beach in Tanzania. Bats entered and exited through a perpendicular natural chimney. Usually *Cardioderma* roosts alone; however, on one occasion Kulzer (1962) found *Cardioderma* sharing a cave roost with *Rousettus aegyptiacus*, *Coleura afra*, *Taphozous hildegardeae*, *Rhinolophus* sp., and *Hipposiderus* sp.

*Cardioderma* feeds primarily on large (typically >25 mm) terrestrial arthropods (McWilliam, 1987; Vaughan, 1976). During the dry season, beetles in the family Scarabaeidae, Tenebrionidae, and Carabidae are of particular importance, with centipedes and scorpions being taken occasionally. During the wet season, terrestrial

beetles also constitute the majority of the diet, but are supplemented with locusts, katydids, and moths. Small vertebrates, such as bats and frogs, are also consumed (Ryan and Tuttle, 1987; Vaughan, 1976). Under laboratory conditions (Ryan and Tuttle, 1987), *Cardioderma* consume live and freshly-killed prey. *Cardioderma* appears to be at least partially dependent upon terrestrial foraging for the entire year, but is flexible enough to exploit leaf gleaning for orthopterans and aerial pursuit for moths when these insects are abundant (Vaughan, 1976). Local movements of individuals and colonies likely result from fluctuations in prey availability (Vaughan, 1976). There are no reports of predation on African false vampire bats.

Nothing is known about the effects of human activity on the population dynamics of *Cardioderma* and there are no detailed records of population change over time. This species is not listed as threatened or endangered by any national or international organization.

A tick (*Argas boueti*) and mite (*Labidocarpus yunkerii*) have been reported to parasitize *Cardioderma* (Anciaux de Faveaux, 1971, 1976). To reduce ectoparasites, *Cardioderma* pairs spend approximately 1 h per day grooming themselves and each other (Vaughan, 1976). A bacteria (*Borrelia* sp.) isolated from *Cardioderma* has a congener that causes relapsing fever in man (Hill and Smith, 1984).

**BEHAVIOR.** During the day, African false vampire bats are constantly vigilant and easily disturbed (Kingdon, 1974; Vaughan, 1976). They emerge from their roosts singly, in pairs, or in small groups approximately a half-hour after sunset. Dispersal from the roost to foraging sites involves a series of short flights interrupted by periods when the bats perch in low vegetation. Vaughan (1976) suggested that *Cardioderma* usually does not disperse much more than 1 km from the day roost because he caught individuals 0.7 km and 1.2 km from the roost and observed that bats on several occasions remained throughout the night <400 m from the roost.

Individuals, usually breeding pairs, occupy exclusive feeding territories (McWilliam, 1987; Vaughan, 1976). Vaughan (1976) found four territories that were 1.01, 0.55, 0.11, and 0.10 ha in size and suggests that smaller territories are more typical. Prior to foraging in the evening, males sing at various perches to demarcate their territory. Territorial behavior during the long dry season (post-breeding) may depend upon insect abundance. Where insect abundance is low, territorial behavior breaks down (Vaughan, 1976), but maintenance of territorial behavior at a more coastal site may have been due to higher insect availability (McWilliam, 1987).

*Cardioderma* uses a sit-and-wait hunting strategy while hanging from perches that are usually 0.5 to 3 m above sparsely vegetated ground. They twist their bodies around the axis of their legs to scan the area below (180° in either direction) with their ears and eyes. Vaughan (1976) estimates that the area surveyed has a radius greater than the height of the perch. It appears that prey-generated sounds are necessary for the bats to localize and capture prey (Ryan and Tuttle, 1987). Echolocation calls are often not used by bats when prey are approached and seized (Ryan and Tuttle, 1987). *Cardioderma* normally glide down at an angle of <45° from their perches to attack prey, although hovering occasionally follows an initially unsuccessful foraging attempt. The total duration of these flights averages 5 s (Vaughan, 1976). Typically, prey are quickly seized and taken back to the roost where legs and wings are culled before the body is eaten. Handling times vary from 1 min 30 s to 5 min 10 s ( $n = 5$ —McWilliam, 1987).

During the wet season, *Cardioderma* "hawks" large moths and gleans locusts and katydids from vegetation. The hawking strategy involves direct chases that take the bat <20 m from the perch and last <10 s (Vaughan, 1976).

Seasonal changes in nocturnal activity patterns of *Cardioderma* are pronounced, probably due to seasonality of rainfall and associated changes in vegetation and insect availability (Vaughan, 1976). Presumably because insects are more widely spaced during the dry season, bats make longer flights between perches and more of these flights per hour between 2000 h and 0500 h in the dry season than in the wet season (Vaughan, 1976). This results, on average, in bats spending 27 min in flight during this period in the dry season versus 5 min in flight during the wet season.

A mother's call announces her position to her young, and newly volant young follow their mothers from perch to perch (Vaughan, 1976). By following the female, the young become familiar with her

foraging routine. The breakdown and subsequent re-establishment of feeding territories following the breeding season increases the ease with which young adults can occupy exclusive feeding territories (Vaughan, 1976).

*Cardioderma* appears to be monogamous (McWilliam, 1987), but it is not known when the pair bond is formed or when mating occurs. There is some evidence, however, that the pair bond is maintained for more than one breeding attempt (McWilliam, 1987). Interactions between the sexes include simultaneous use of the same roost and joint circling flights.

**GENETICS.** Nothing is known about the genetics of this species.

**REMARKS.** *Cardioderma* comes from *cardio* meaning heart and *derma* meaning skin. *Cardioderma* is sometimes referred to as the heart-nosed bat (Kingdon, 1974). Based on hyoid morphology, Griffiths et al. (1992) suggest that *Cardioderma cor* is the sister species to the *Lavia-Megaderma* group. This differs from Hand's (1985) phylogeny, which identifies *Cardioderma cor* as the sister species to the *Megaderma-Macrotus* group.

I thank Brian Boyle for taking the skull photographs, M. D. Tuttle (Bat Conservation International) for supplying the photograph of *C. cor*, and M. B. Fenton, T. A. Vaughan, and especially A. V. Linzey for making valuable comments on earlier versions of this account.

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- Editors of this account were ALICIA V. LINZEY, KARL F. KOOPMAN, and ELAINE ANDERSON. Managing editor was ALICIA V. LINZEY.
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